before his death, and his wife survives him. An appreciation of his work by Prof. F. Cohn is contained in *Astronomische Nachrichten,* No. 5053.

THE death is announced, at the age of fifty-eight, of PROF. SAMUEL SHELDON, professor of physics and electrical engineering at the Polytechnic Institute of Brooklyn since 1889. Prof. Sheldon was at one time assistant to Kohlrausch, with whom he was associated in the former's determination of the ohm. In 1906 he was elected president of the American Institute of Electrical Engineers.

THE death of SIR LINDSAY WOOD, BT., on September 22, at eighty-six years of age, is announced in the Journal of the Royal Society of Arts. Sir Lindsay was born in 1834, and educated at the Royal Kepier Grammar School, Houghton-le-Spring, and King's College, London. He served as a mining engineer apprentice at Hetton Collieries, of which in 1866 he became managing director. He was also on the boards of several other coal companies and allied undertakings. From 1875–78 he was president of the Northern Institute of Mining and Mechanical Engineers, and in 1879 he served on the Royal Commission on Accidents in Mines. His chief work was a series of elaborate and exhaustive experiments on the pressure of gas in coal. Sir Lindsay was created a baronet in 1897, and served as Deputy-Lieutenant and High Sheriff of the County of Durham.

DR. HARMON NORTHRUP MORSE, professor of inorganic and analytical chemistry and director of the chemical laboratory at Johns Hopkins University, died recently in his seventy-second year. Having graduated at Amherst in 1873, Dr. Morse returned to that college as an assistant in chemistry in 1875, after a period of study at Göttingen. In the following year he was appointed associate professor at Johns Hopkins, and in 1891 was promoted to a full professorship. He carried out many original researches on osmotic pressure and related subjects.

Notes.

AT the concluding meeting of the International Congress of Physiologists, which was held in Paris on July 16–20, it was unanimously resolved, on the invitation of Sir E. Sharpey Schafer, to hold the next meeting in Edinburgh in 1923.

THE annual oration of the Medical Society of London is to be delivered in May next by Lord Dawson of Penn. The Lettsomian lectures of the same society are to be given in February and March next by Mr. George E. Gask.

THE British Electrical and Allied Industries Research Association has been approved by the Department of Scientific and Industrial Research as complying with the conditions laid down in the Government scheme for the encouragement of industrial research. The association may be approached through Mr. E. B. Wedmore, Electrical Research Committee, c/o Electrical Development Association, Hampden House, 64 Kingsway W.C.2.

THE following arrangements have been made by the Royal College of Physicians of London:—The Horace Dobell lecture will be delivered by Sir William B. Leishman, at 5 o'clock on November 2, on "An Experimental Investigation of the Parasite of Tick Fever, *Spirochaeta Duttoni*"; the Bradshaw lecture by Dr. C. Wall, at 5 o'clock on November 4, on "Chorea"; and the FitzPatrick lectures by Dr. E. G. Browne, at 5 o'clock on November 9 and 11, on "Arabian Medicine after Avicenna."

THE council of the Chemical Society has arranged for the following lectures to be held during the coming session:—October 28, Emil Fischer memorial lecture, Dr. M. O. Forster; December 16, Some Properties of Explosives, Sir Robert Robertson; April 7, 1921, Mass Spectra and Atomic Weights, Dr. F. W. Aston; and June 16, 1921, The Natural Photosynthetic Processes on Land and in Sea and Air, and their Relation to the Origin and Preservation of Life upon the Earth, Prof. Benjamin Moore. By the courtesy of the council of the Institution of Mechanical Engineers, the first two lectures will be held in the lecture hall of that institution (Storey's Gate, Westminster, S.W.1). Informal meetings, at which fellows are invited to show experiments and apparatus, will be held at Burlington House on November 18 next and on February 3 and May 19, 1921.

PROF. F. SODDY's review of the activities of the Department of Scientific and Industrial Research published in the *Observer* of September 26 has been followed up in the same newspaper by letters from Dr. J. W. Evans and Mr. J. W. McConnell. Prof. Soddy remarked: "To-day a new kind of science—Government science—is being step by step built up, not for humanity, but its masters; not for the community, but big business"; emphasised the fundamental change of policy which accompanied the creation of the new department for the administration of funds for industrial research; and contrasted the generous treatment and comparative freedom from Government control accorded to industrial associations with the arbitrary methods of dealing with individual research workers. Dr. Evans suggests that the mistakes of the Department are attributable to the "fundamentally wrong-headed attitude adopted by the nation generally with regard to our scientific societies and the science faculties of our universities," and instances the disabilities under which these bodies suffer in carrying on their work. He deplores also the decision of some university authorities to raise their fees at a critical time in the nation's history. Mr. McConnell, who acted as chairman of the provisional committee for forming the Cotton Research Association, although in general sympathy with the views expressed by Prof. Soddy, is of the opinion, which is not shared, however, by scientific workers generally, that "the rewards of the research of whatever kind should have been primarily secured to those who found the money to pay for it."

THE wonderful achievements of Rolf, the thinking Airedale terrier, bid fair to be eclipsed by the marvel of his daughter Lola. Lola passed at the age of two years into the keeping of Miss Kindermann when she could only say "yes" and "no," but after a few days of schooling the dog could read and count. In one day's lesson she could tell the hour by the clock. In the same way she acquired a knowledge of days, months, measurements, and musical notes, could forecast the weather, and gave evidence of "filosofia morale." Dr. W. Mackenzie, from whose "Gli Animali 'Pensanti'" (*Quaderni di Psichiatria*, 1920) these particulars are taken, vouches for Miss Kindermann's ability, veracity, love of animals, and ignorance of psychology. He does not attribute all the intelligence to Lola, but believes that there is a *rapporto medianico* between the supra-liminal consciousness of mistress and the sub-liminal unconsciousness of pupil. Seeing, however, that Dr. Neumann's experiments (duly discussed in the pamphlet) place Rolf's achievements in a new light, it may be well to await further observations on Lola before passing judgment on Dr. Mackenzie's conclusions. The trouble is that negative results may be explained as due to lack of the said *rapporto*.

THE study of place-names, of great importance in American geography, has been much advanced by a monograph entitled "Yurok Geography," by Mr. T. T. Waterman, published in the series of publications of the University of California, vol. xvi., No. 5. This summarises a great mass of material collected by Dr. A. L. Kroeber and the writer among the Yurok Indians along the Klamath River and in the adjacent region of north-western California. Many of these primitive Indian names are now used by white settlers, and appear in the ordinary maps of this region in anglicised form. Their identification and interpretation naturally present much difficulty, but the present monograph, with its careful lists and maps, will be of interest to both the geographer and the philologist.

THE system of geomancy or divination known as Raml, "sand," is common among the Arabs. At a propitious hour, noon, or one-third of the day before or after noon, the Khattāt, or "writer," prepares a smooth patch of sand, while his client places the tip of the middle finger of his right hand on the ground and states mentally the object of his quest. Then the diviner makes finger-prints at random in the sand and counts off the prints of each line in pairs to see if it contains an odd or an even number. There are, on the whole, sixteen possible figures in the diagrams which he makes, each of which has its special name and meaning. The nomad Arab in the Sudan, says Mr. R. Davies, who gives a full account of the system (*Sudan Notes and Records*, vol. iii., No. 2), spends much of his time in search of lost or stolen animals, and this system of divination has thus arisen. It seems to be successful, for Mr. Davies writes: "On the only occasions, three in number, when serious trial of the Khatt has been made in the presence of the writer, the forecast of the Khattāt has each time been justified by the result."

IN an elaborate monograph (University of California Publications in American Archæology and Ethnology, vol. xvii., No. 1) Mr. Paul Radin discusses the sources and authenticity of the history of the ancient Mexicans. These sources, which are of great extent, fall into two types: the actual old Indian codices, of which there are but a few extant, and the works of Christianised Indians and Spaniards. The vast majority of the old manuscripts have disappeared, as well as the copies made of them. As late, however, as 1746 Boturini was able to make a large collection dealing with all the aspects of the ancient culture. Mr. Radin in this monograph has made a critical study of a large number of ancient documents, and provides English translations of the most important passages. The value of some of these materials is doubtful, but the Nahua peoples had a complex calendar system and a rude system of writing, and as they were deeply interested in the traditions of their migrations, it seems clear that these records contain information of much value to ethnologists. Mr. Radin has done good service to science in his careful account of these manuscripts and by his translations of the most important records.

DURING the Mahdist occupation of the Sudan (1885–98) coins were struck by the Mahdi at Khartum, and later by the Khalifa at Omdurman. Many of these coins have now become scarce, and Mr. H. S. Job, in *Sudan Notes and Records* (vol. iii., No. 3), has done good service to numismatics by giving a full account of this example of the debasement of currency in the hands of a despotic ruler, and by providing a full catalogue, with illustrations, of the various types of mintage. After the fall of Khartum in 1885 considerable treasure of Egyptian and English gold coins, the Mejidi and Maria Theresa dollars, with smaller Egyptian coins, fell into the hands of the Mahdi, who determined to have the bullion melted down and recoined. It was decided that two coins should be struck, a gold pound and a silver dollar, to which later a half-dollar was added. For the first the Egyptian gold piece of 100 piastres of Sultan Abd-al-Mejid was taken as the model, the name of the Sultan being replaced by the words "By Order of the Mahdi." Though these coins were of good quality they were regarded with mistrust, and circulated at less than their par value, while many foreign coins, though much worn, remained in circulation. It may be hoped that a full series of these interesting coins has been provided in our museums.

IN a detailed analysis of the inheritance of hoariness in stocks, Miss Saunders (*Journ. Genetics*, vol. x., No. 2) shows that a graded series from the fully hoary form *incana* to the completely glabrous form can be obtained. Historical records indicate that the extreme glabrous form was probably the first to arise from *incana*, being mentioned as early as

1588, while Linnæus mentions the rare half-hoary *semi-incana* in 1762. Crosses of these forms produce a series of intermediate factorial combinations, including a type with a single hair on the tip of each leaf. It is concluded that the "factor" for a particular degree of hairiness represents a particular condition of physiological equilibrium subject to environmentally produced fluctuations.

IN the Journal of the Royal Microscopical Society (1920, part 2) Mr. T. E. Wallis describes a method of quantitative microscopy by use of Lycopodium spores. By a sufficiently thorough mixing of the materials to be tested with the spores and by the use of a suitable suspending medium, the author finds it possible, by making a number of counts of the spores in different fields of view, to obtain results of an order of accuracy equal to many of those obtained by chemical operations both qualitative and quantitative. As examples are cited the determination of the proportion of maize-starch that had been added to some ordinary wheat-flour, and the determination of the number both of starch grains per milligram of maize-starch and of pollen-grains per milligram of insect-powder; the last-mentioned supplies an index of the value of the powder.

DR. W. MACKIE has shown that monazite is widely distributed in the granites of the North of Scotland, and it has now been found by Dr. A. Gilligan in almost all the beds of the Millstone Grit of Yorkshire, doubtless derived from this northern source ("The Petrography of the Millstone Grit of Yorkshire," Quart. Journ. Geol. Soc., vol. lxxv., p. 271, 1920).

THE "Final Report of the Work of the Commission on Munition Resources, Canada" (Toronto, 1920), besides useful notes on recent prospecting, contains (pp. 58–88) an account of trenches made for the investigation of bog-manganese ore, which may be of service to those interested in such deposits in Ireland. There seems not much hope of competition between the bog material and the hard ores of the ordinary mines. We have yet to learn how far selective action by bacteria is responsible for the precipitation of manganese oxides in swamps. Mr. Uglow's practical report naturally leaves the matter open.

DR. R. S. LULL describes in the *American Journal of Science* (vol. l., p. 83, 1920) two "new Tertiary Artiodactyls" from remains discovered in Nebraska in 1914 by an expedition from Yale under his guidance. The deposits are of Late Miocene or Early Pliocene age. A very pleasing restoration is given of a new antelope, *Aletomeryx gracilis*, of which abundant material has been obtained, including nineteen skulls, both male and female. The name, meaning "wandering ruminant," is chosen on account of the migratory powers indicated by the delicacy of the limbs. The limb-bones are, indeed, generally broken.

FROM the General Report of the Survey of India for 1918–19 we learn that the curtailment of work owing to war conditions continued, several survey parties being engaged in Mesopotamia, East Africa, and elsewhere out of India. Of the topographical map on the one-inch scale 57 sheets were published during the year in place of the pre-war figure of 150 to 200. About 1500 one-inch sheets have now been published out of a total of 6218. Thirty half-inch and 11 quarter-inch, or "degree," sheets were published. The half-inch map is now the tactical map of India, and 177 of the 630 sheets are available. The "degree" sheets are making slower progress, and their total is now only 52 out of 450. No further sheets of La Carte Internationale (1 : 1,000,000) appeared during the year, but two sheets of the India and Adjacent Countries Series (1 : 1,000,000) were published. The report includes complete indices of all sheets published by the Survey of India.

THE Mines Branch of the Department of Mines of Canada has just issued a valuable monograph on graphite, written by Mr. Hugh S. Spence. It describes in detail the important Canadian occurrences of this mineral, and also reviews all other known sources of supply throughout the world. It is interesting to note that in 1913 Germany and Austria together produced practically one-half of the world's total supply, but that since then the American output has been nearly trebled. An interesting account is given of the various methods used for the concentration of graphite, for which purpose the flotation process appears now to be the most favoured, and the manufacture of artificial graphite is also described. An important section is devoted to the industrial applications of graphite; it is stated that the world's production of natural graphite is utilised in approximately the following proportions: For crucibles, 75 per cent.; for lubricants, 10 per cent.; for pencils, 7 per cent.; for foundry facing and stove-polish, 5 per cent.; and for paints, 3 per cent. The method of manufacture of all these articles is described, as well as that of others not included in the above list, such as graphite brushes for dynamos and motors, graphite electrodes, graphite for dry batteries, for electrotyping, and for various less important purposes. The monograph should prove valuable to all interested in the mining of graphite or the manufacture of graphite articles.

THE United States Geological Survey has just issued an elaborate monograph on the economic geology of Gilpin County and adjacent parts of Clear Creek and Boulder Counties, Colorado, by Mr. E. S. Bastin and Mr. J. M. Hill. This district includes most of the mining camps of Colorado that are producing minerals of economic importance, including the well-known auriferous pyritic ores of Gilpin County, the gold and silver veins of Clear Creek County, the lead ores of Leadville, the telluric gold ores of Telluride, and many others. In addition to gold, silver and lead ores, the district here described produces also ores of zinc, copper, uranium and tungsten, the gold production being, however, economically by far the most important. The monograph describes the general topography of the area, spoken of here as the Central City quadrangle; the geology is described in detail, particular attention being devoted to the igneous rocks, amongst which the monzonites are the most important. Chapters are devoted to the economic geology and to the general features and origin of the various ore deposits, each of the more important ores being discussed separately. An interesting chapter is devoted to the methods of ore-treatment, the history of the development of the so-called Colorado or Gilpin County method of gold-milling being clearly traced, as also its displacement by the more recent processes of cyanidation and flotation. Justice is also done to the development of the smelting process, under Mr. R. Pearce, from its small beginnings at Blackhawk, removed afterwards to Argo, close to Denver. Statistical tables of the output are given, showing the economic importance of this district. The remainder of the book is taken up with a detailed description of all the mines of importance, the geological relationships of the ore-bodies being worked out in much detail.

The Journal of the College of Science of the Imperial University of Tokyo for May 10 last contains an important paper, of interest to the students of the genesis of mineral deposits, under the title of "A Contribution to the Knowledge of the Cassiterite Veins of Pneumato-Hydatogenetic or Hydrothermal Origin: A Study of the Copper-Tin Veins of the Akénobé District in the Province of Tajima, Japan," by Takeo Katō. The district in question contains a system of practically parallel veins worked at first for copper, but afterwards found to contain important proportions of tinstone and wolframite. The author holds that "the veins of the Akénobé district are all consanguineous, and all gradations exist between the copper veins containing little or no cassiterite and the copper-tin veins containing much of the same mineral." The veins occur chiefly in Palæozoic slates. The abnormal feature of the occurrence is the fact that the district shows important exposures of intrusive dioritic rocks, forming either large masses or offshoots from these. There are, it is true, dykes of andesites and porphyrites, but these cut the veins "and are clearly later in generation than the latter." "No granitic or allied acid plutonic rocks have been observed," and the author concludes definitely that the veins are related genetically to the dioritic rocks—an occurrence which, though common enough so far as copper-bearing veins are concerned, is probably unique in respect of tin veins. The author's summary of the genesis of these veins is as follows: "The copper-tin veins of the Akénobé district were deposited from hydrothermal solutions, still containing fair quantities of mineralisers, at gradually decreasing temperatures, chiefly considerably below 360° C. The solutions had naturally a temperature far above the critical point of water (364° C.), and were gaseous in character, after emanation from the consolidating diorite magma. As they ascended through the surrounding slate complex the rate of fall of the temperature was very rapid, and they soon changed to superheated hydrothermal solutions."

The chief periods of seismic activity of the well-known Comrie centre are from 1788 to 1801 and from 1839 to 1844. Since the latter year very few shocks have been felt. Some are recorded from time to time in Perrey's annual catalogues. During the last thirty years five have been felt, all of them slight and disturbing an area of at most a few square miles. Three of these occurred towards the close of last century—on July 12, 1894, July 12, 1895, and August 22, 1898. In the present year a slight increase of activity is shown by the occurrence of a shock of intensity 3 (Rossi-Forel scale) on July 21, and of a slightly stronger shock (intensity 4) on September 14.

Canada is keeping well abreast of the times in meteorology, and its Monthly Record of meteorological observations, which includes data from the Colonies of Bermuda and Newfoundland, will add much of value to the general knowledge of the world's weather. Results for the early months of the present year are to hand. Tables and maps are given showing the monthly average temperature and precipitation, together with differences from the normal over the whole Dominion. The observations are classified for province and district. For many places temperature, atmospheric pressure, and humidity are given for each hour, and the mean monthly averages and totals are well set out, also the mean proportion of bright sunshine for each hour that the sun is above the horizon. Observations of wind direction and velocity and of cloudiness are also obtainable. The detailed observations of wind both from the first- and second-class stations will prove of much value to the aeronaut. No observations are made at present of the form of cloud, or of the direction and speed of either lower or upper clouds. Such observations would be useful in the elucidation of upper-air problems.

An analysis of the rate of ascent of pilot-balloons has been made by Lieut. R. P. Batty, and is published by the Meteorological Office as Professional Notes No. 12. The observations were taken at Butler's Cross, Salisbury Plain, from June to December, 1919. The ascents were not made at fixed hours of the day, but when required by the School of Artillery; 75 per cent. of the ascents were between 9h. and 13h. G.M.T., and mostly during July, August, and September. Average rates of ascent are given for each of the first thirteen minutes. From 225 ascents 1464 minute readings were obtained, and the mean rate of all ascents is 530 ft. per minute. Ascents have been grouped for specified hours of the day, and the mean rate is shown to be greatest at about midday. Ascents are also classified according to the amount of cloud in the sky, and it is seen that more cloud gives an increased rate of ascent. Moderate and strong winds give a higher rate of ascent than light winds, and the rate of ascent for different wind directions is also classified. It is noticed that immediately prior to entering cloud the rate of ascent almost invariably increases, mostly to 600–700 ft. per minute. Rain is said to decrease the rate of ascent by about 20 per cent. The size of the pilot-balloons used was 70 in. or 90 in., and their weight varied from 20 to 30 grams. Tables and diagrams are given showing the variations under the different classifications.

Father Froc has added yet another contribution to his already valuable researches on the typhoons of the Far East, in the "Zi-Ka-Wei Observatory Atlas of the Tracks of 620 Typhoons, 1893–1918." The atlas contains a series of charts showing the actual tracks of the centres of 620 typhoons which have been reported in the Far East during the twenty-six years, 1893–1918. The original purpose of the author was to issue these charts as an appendix to a more general study of the subject, but since the publication of this more comprehensive report has been considerably delayed, it was decided that the appendix should appear at once. Consequently, the atlas contains little more than the charts themselves, with brief explanatory notes on each. It lays no claim to be a theoretical treatise on the structure and origin of these revolving storms. No attempt at classification is made, since the charts are intended solely for the nautical guidance of sailors. The cases are enumerated month by month as they occur, and to avoid confusion and overlapping of the tracks, three charts are allotted to each of the months of maximum frequency (July to October inclusive). The maps cover a wide geographical area, from Cochin China and the Philippines in the south, to Manchuria and the Kurile Islands in the north, while embracing a vast stretch of the Pacific eastwards from the Asiatic mainland to 150° E. longitude. The irregular west-south-westerly motion of occasional storms in this region—chiefly in the China Sea—is clearly shown in the charts, and the author lays stress on the point that navigators should be familiar with the possibility of this unusual movement, even though the vast majority of the storms follow a general north-westerly track, such as is customary in the northern hemisphere. In conclusion, twelve summary maps are given, showing the dangerous zones and the successive changes which take place throughout the year. The atlas is of additional value in that it gives a trustworthy and up-to-date measure of typhoon frequency.

WE have received a copy of Catalogue No. 23 of second-hand books in science just issued by Mr. R. S. Frampton, 37 Fonthill Road, Finsbury Park, N.4. The works listed (some 1100 odd) range over most of the sciences, and the prices asked are very reasonable. The catalogue will be sent free upon application.

DR. WALTER KIDD is publishing through Messrs. H. F. and G. Witherby a work entitled "Initiative in Evolution," which will contribute to the evidence in favour of Neo-Lamarckism, and give especial consideration to the arrangement of the hair in mammals. Messrs. Witherby also give notice of "A Naturalist in Himalaya," by Capt. R. W. G. Hingston, in which attention is given, among other subjects, to geometrical spiders and their work, various species of ants and their organisations, and the nesting instincts of birds.

THE reviewer of "Smithsonian Meteorological Tables" in NATURE of September 30, p. 142, stated that the Tables are not obtainable in the ordinary way. Messrs. W. Wesley and Son, 28 Essex Street, Strand, W.C.2, remind us, however, that they are the agents for the Smithsonian Institution in London, and that the Tables can be purchased from them. The Tables form vol. lxix. of the Smithsonian Miscellaneous Collections, and not vol. lix., as given at the head of the review.

Our Astronomical Column.

PROF. PICKERING'S LUNAR OBSERVATIONS.—Prof. W. H. Pickering has for many years been making a careful study of certain lunar formations under all angles of illumination, finding striking changes of relative luminosity of adjacent markings in the course of the lunar day, which he ascribes to the presence of snow or hoar-frost, or in some cases to vegetation. There can be only one opinion as to the interest and value of the observations, whether Prof. Pickering's conclusions are accepted or not. His latest study (*Popular Astronomy*, August and September) is of the region round the crater Conon in the Apennines and the neighbouring formation of Bradley. He asserts that this region contains snowfields, clouds, and tracts covered with vegetation. He distinguishes the clouds from the snowfields as being more yellowish, less brilliant, and more subject to change. One note that he makes about them would seem to throw some doubt on their assumed nature. "No clear evidence of motion due to wind has ever been seen in the lunar clouds, which apparently merely form and dissolve *in situ.*" The white snow-patches, on the other hand, which appear hazy at sunrise, are stated to show some drift; the "vegetation" regions darken conspicuously as the sun rises higher upon them. The author asserts that volcanic activity is by no means extinct on the moon, the floor of Plato being stated to be an active region emitting many steam-jets.

There cannot be much doubt about the relative change of brightness of the different markings, but it does not appear that the author has given enough consideration to the possibility that it may arise from differences in the composition of the rocks or of their degree of slope and of smoothness. While the occurrence of snow, cloud, and vegetation cannot be ruled out as impossible, it is at least somewhat difficult to reconcile with the tenuity of atmosphere that is demonstrated by the practical absence of refraction in occultations and eclipses.

THE SUN'S MAGNETIC FIELD.—The *Observatory* for September contains an article by Dr. F. H. Seares, written at Prof. Hale's request, giving an account of the researches made at Mount Wilson since 1908 on the sun's magnetic field. The investigation was suggested by the discovery of the Zeeman effect in the spectra of sun-spots, which were surrounded by hydrogen vortices. In the case of the general field the spectral shifts are extremely minute, less than one-thousandth of an angstrom, and it is only the remarkable accordance in the results that gives confidence that the effect is a real one, the shifts being of the same order as accidental errors in the measures. The precaution was taken that the measurer should not know in which direction the shift on any plate was likely to be, so that all bias was eliminated. Comparatively few of the spectral lines were found to be suitable for the research, and the results depend chiefly on iron and chromium lines. A first solution showed that the northern hemisphere had negative polarity, and that the magnetic axis was close to the rotational one. It was afterwards found that the inclination of axes is about 6°, and that the magnetic axis revolves about the other in 31·44 days. The investigation indicates that the field strength diminishes rapidly with increasing elevation, falling from 50 to 10 gausses in 200 km. It will be noted that the shifts in this investigation are much smaller than in the Einstein spectral test; but differential measures suffice here, while in the other case absolute ones are required.